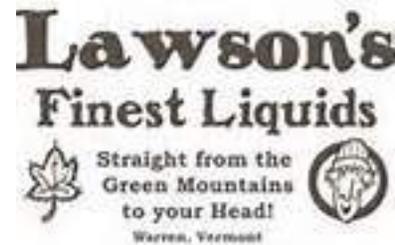
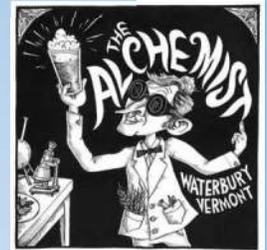


Brewery Water/Wastewater Conservation



November 25, 2019



Presented By:
Scott R. Shirley, Michael A. Smith, PE and Shane M. Mullen, PE CPESC
to the
Vermont Green Brewery Cohort



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Presenters



- **Scott Shirley – Head Brewer**
- **Michael Smith, PE – Team Leader**
- **Shane Mullen, PE CPESC – Senior Project Engineer**

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Why is Brewery Water Conservation Important?



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Why is Brewery Water Conservation Important?

- Impacts Environment
- Impacts Community



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Why is Brewery Water Conservation Important?



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Brewery Water Issues

- Cost of water capacity
- Brewery water needs conditioning (\$)
- More water use is more wastewater generated
- Environmental impacts

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Brewery Wastewater Issues

- Management of wastewater and residuals
- Trouble finding capacity
- Cost of capacity
- Taking focus away from brewing



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Community Wastewater Issues

- Environmental Management
 - Organic Load from brewing
 - Nutrient Load from brewing
- Capacity limitations
- Regulatory restrictions
- Conflicts with growth goals
- Inconsistent Approach



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What's In the Wastewater

- Organics/Solids:

- Spent Grains

- Yeast

- Biochemical Oxygen Demand (BOD₅):

- ✓ Best Management Practices – 2,500 to 3,000 mg/L

- ✓ Poor – 10,000 to 15,000 mg/L

- Total Suspended Solids (TSS):

- ✓ Best Management Practices – 500 to 1,000 mg/L

- ✓ Poor – 8,000 to 15,000 mg/L

- pH

- ✓ Typically in the range of 5 – 6 S.U.



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What's in the Wastewater

- Municipal Wastewater Treatment Facilities
 - ✓ BOD₅ - 250 to 350 mg/L
 - ✓ TSS - 250 to 350 mg/L
 - ✓ pH - 7 to 8.5 S.U.

A little brewery wastewater = **A LOT OF CAPACITY**



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Best Management Approach

- Side Streaming:

- ✓ Spent Grains
- ✓ Yeast
- ✓ Trub



- First Rinse Management:

- ✓ Collect additional solids and yeast



- Pre-treatment:

- ✓ Conditioning
- ✓ Aerobic Treatment
- ✓ Anaerobic Treatment



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Lawson's Finest Liquids

- Water Conservation:
 - ✓ Canning - Can Rinse
 - ✓ Cooling Water
 - ✓ CIP System:
 - ❖ Lauter Tun
 - ❖ Bright Beer Tanks



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Lawson's Finest Liquids

- Minimize Wastewater Generation:
 - ✓ Side Streaming
 - ❖ Trub
 - ❖ Tank Bottoms
 - ❖ First Rinse
 - ✓ Keg Returns
 - ✓ Waste Beer from Taproom



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Wastewater Pre-Treatment

- Conditioning
- Aerobic
- Anaerobic

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Conditioning

- Typically for Municipal Connections
- Settling and Buffering
- pH Adjustment
- Dissolved Oxygen (D.O.)
- Effluent Monitoring:
 - Flow
 - DO
 - pH



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Aerobic Pre-Treatment

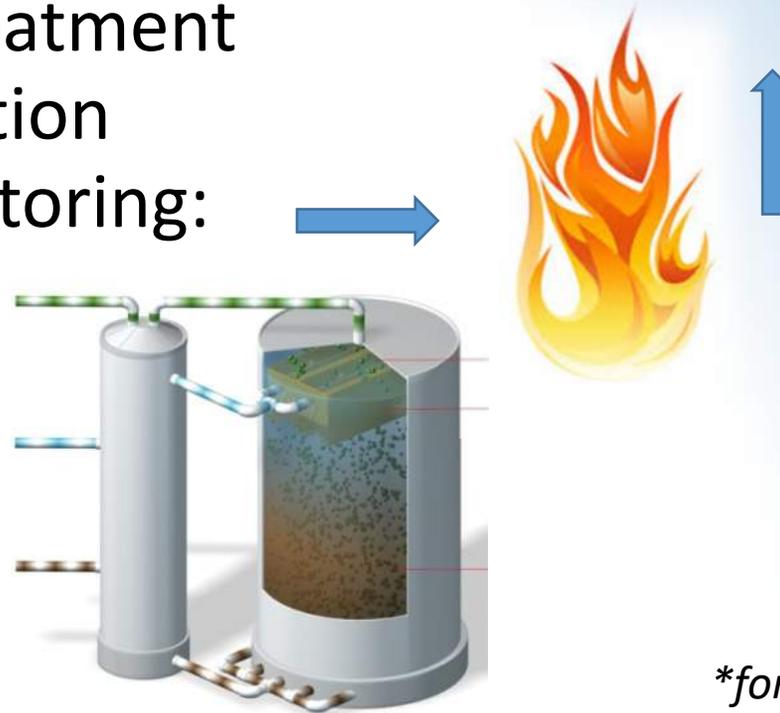
- For Municipal Connections and In-ground
- Settling and Buffering
- pH Adjustment
- Aerobic Treatment
- Solids Separation
- Effluent Monitoring:
 - Flow
 - DO
 - pH
 - BOD
 - TSS



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Anaerobic Pre-Treatment*

- For Municipal Connections
- Settling and Buffering
- pH Adjustment
- Anaerobic Treatment
- Solids Separation
- Effluent Monitoring:
 - Flow
 - DO
 - pH
 - BOD
 - TSS

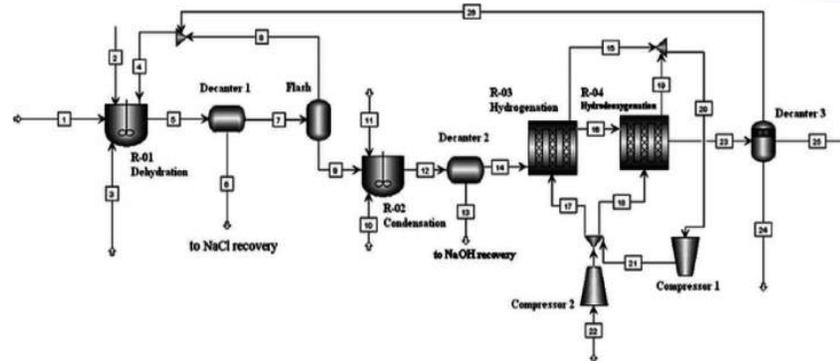


**for larger breweries*

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When is Pre-treatment Required

- Any Subsurface Disposal
- Municipal Connections:
 - ❑ Organic Loading is $> 5\%$ of Municipal Capacity
 - ❑ Hydraulic Loading is $> 5\%$ of Municipal Capacity
 - ❑ If community requires it in their ordinance



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What Brewers May Need to Do

- Request Treatment Capacity from Community
 - Negotiate High-strength WW Agreement
 - Permitting
 - Design Review by Municipality and State
 - Residuals (spent materials) Management
 - Effluent Sample/Monitor/Report



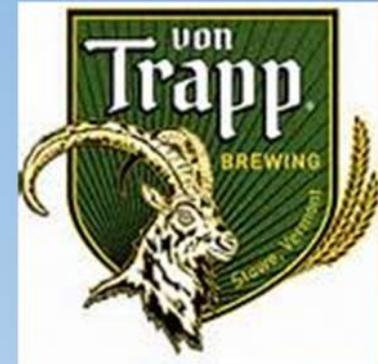
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Planning Considerations

- Work with a qualified engineering consultant
- Detailed Wastewater Quality Analysis
- Evaluate Packaged and Component Systems
- Pilot Packaged Equipment
 - Hire a Licensed Wastewater Operator
 - Consider Long-term O&M
 - Consider Long-term Goals for Growth



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Trapp Brewery – Stowe, VT



Background:

- 50,000 bbl/year – New Brewery
- Industrial capacity at Stowe WWTF
- pH adjustment
- Flow, pH and DO monitoring

Project:

- Conditioning (pH)
- No BOD removal
- Cost: \$300,000



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Trapp Brewery – Stowe, VT



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Trapp Brewery – Stowe, VT



First Rinse Management



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Alchemist Brewery – Stowe, VT



Background:

- 9,000 bbl/year – New Brewery
- Need capacity at Stowe WWTF
- pH adjustment
- BOD Removal
- Flow, pH and DO monitoring

Project:

- Settling
- Conditioning (pH)
- BOD removal (MBBR)
- Cost: \$750,000
- \$4,000 per lb. BOD rem./day



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Alchemist Brewery – Stowe, VT



Yeast Not Good



Pilot Testing

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Alchemist Brewery – Stowe, VT



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Alchemist Brewery – Stowe, VT



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Woodstock Inn Station & Brewery

Woodstock, NH

Background:

- 10,000 bbl/year – Existing Brewery
- Heavy BOD load to Municipal WWTF
- pH adjustment
- BOD Removal – Failed System
- Flow, pH and DO monitoring

Project:

- Settling
- Conditioning (pH)
- BOD removal (Trickling Filter)
- Cost: \$500,000
- \$2,300 per lb. BOD rem./day



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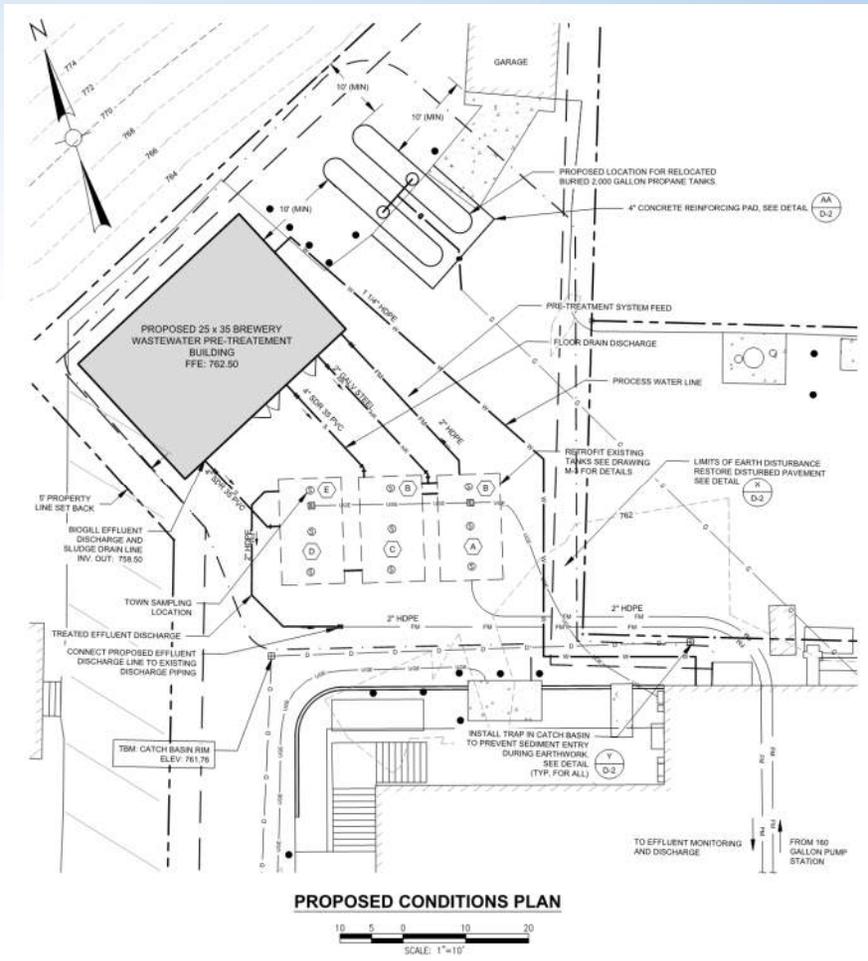
Woodstock Inn Station & Brewery



Pilot Project

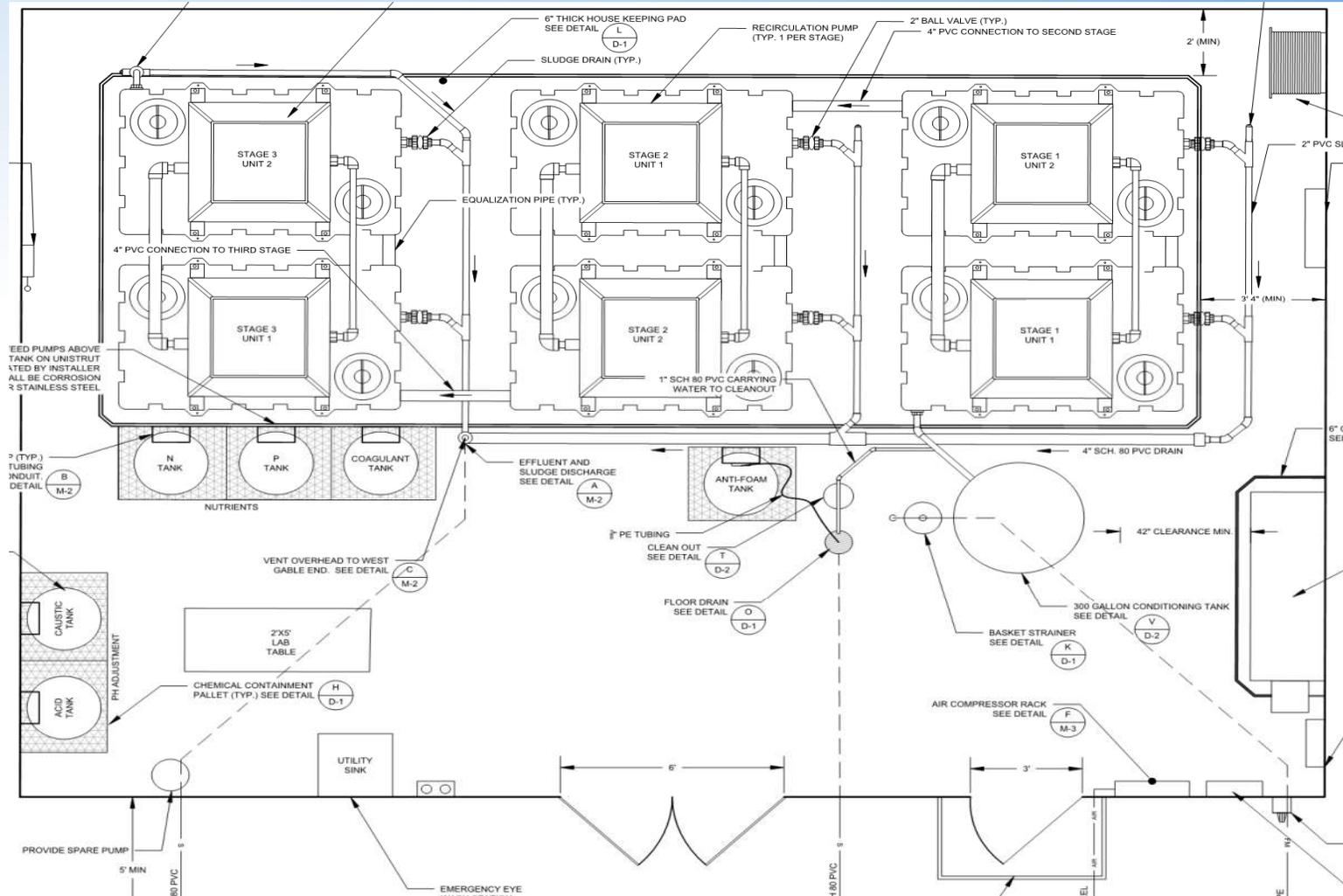
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Woodstock Inn Station & Brewery



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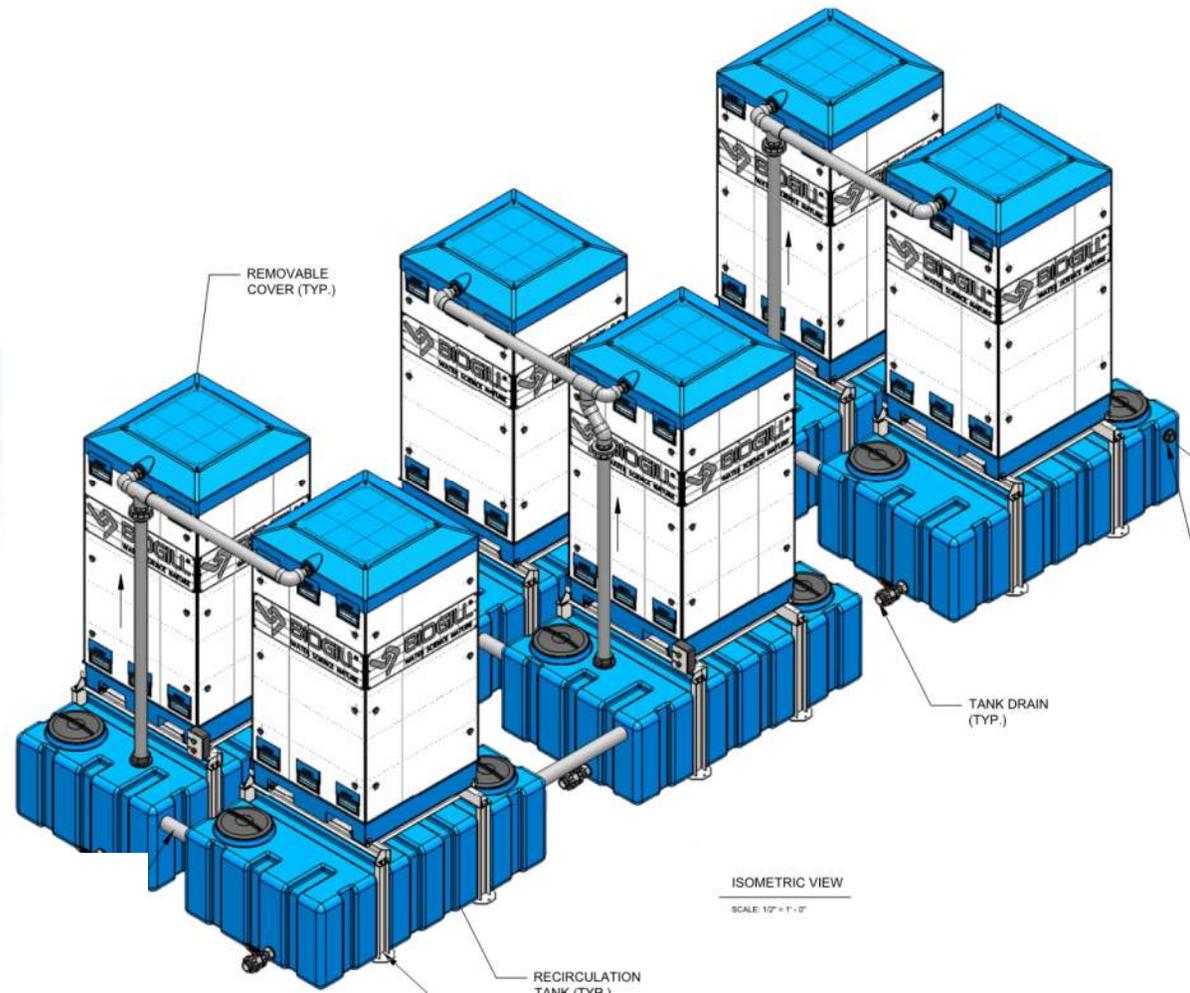
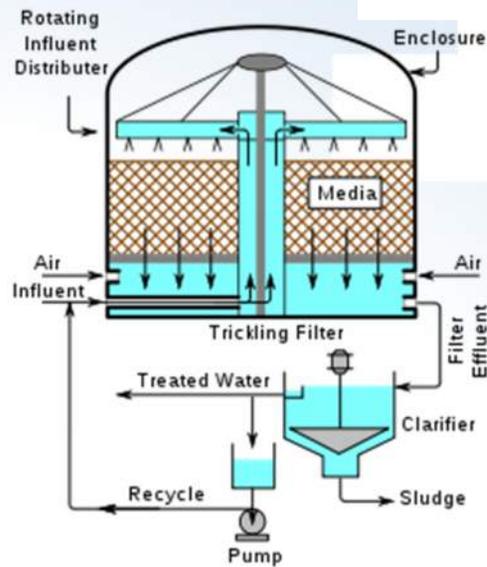
Woodstock Inn Station & Brewery



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Trickling Filter



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Biomass Growth

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Woodstock Inn Station & Brewery



Biomass Growth

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Woodstock Inn Station & Brewery

Key Design Considerations:

- Re-used much of the existing process equipment to save cost
- “calamity” storage to protect Pre-treatment System
- Primary Settling
- Equalization for biological process
- Flow metering (recording)
- Composite sampling capabilities
- PLC controls

Results:

- Domestic Strength Wastewater Discharged
- Solids accumulation at the Municipal WWTF back to normal

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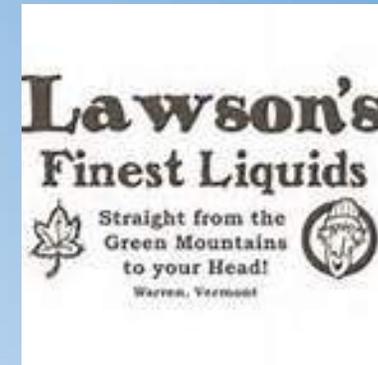
Lawson's Finest Liquids – Waitsfield, VT

Background:

- 14,000 bbl/year – New Brewery
- Subsurface Disposal
- pH adjustment
- BOD Removal
- Flow, pH and DO monitoring

Project:

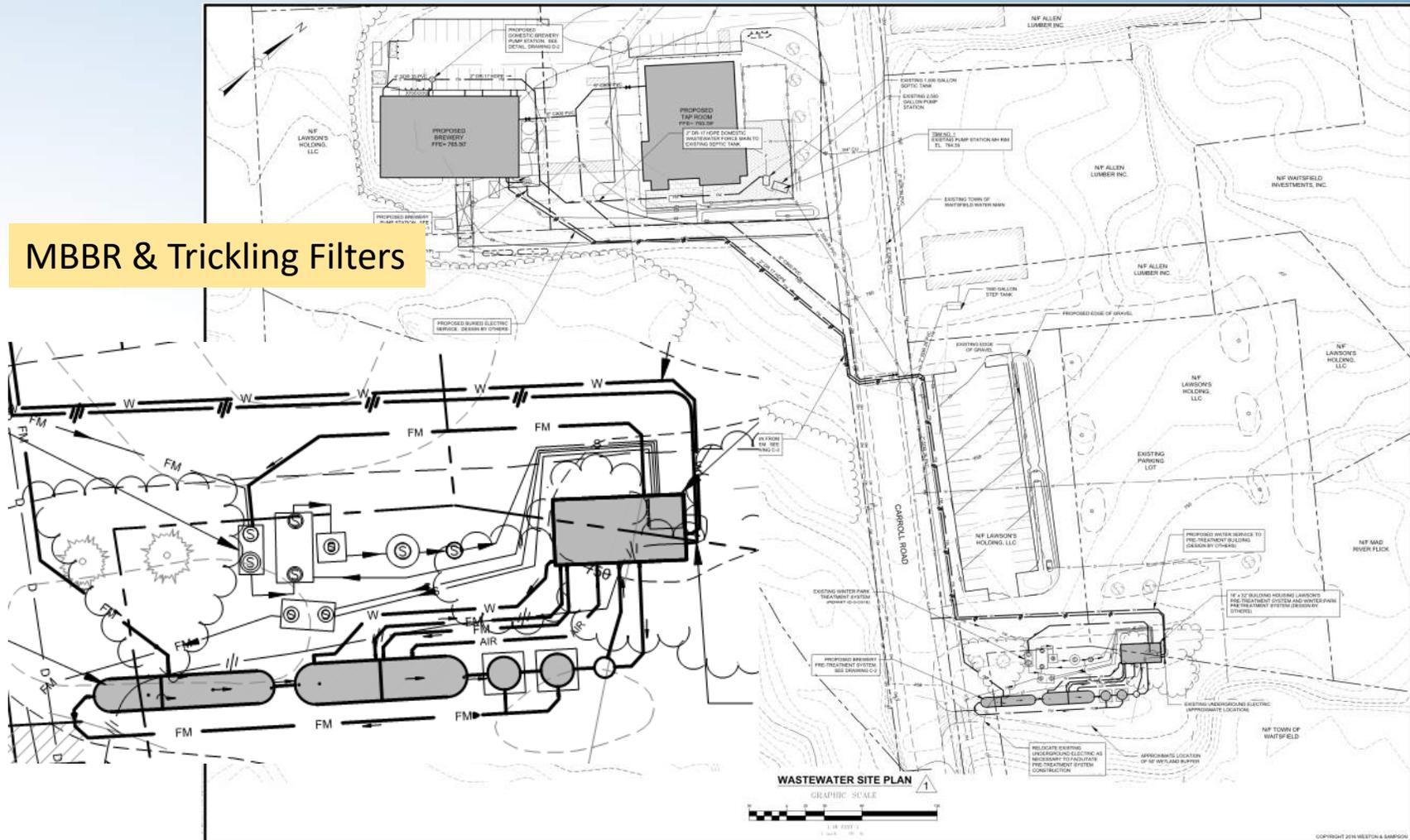
- Settling
- Conditioning
- BOD removal
- Cost: \$700,000
- \$4,500 per lb. BOD rem./day



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Lawson's Finest Liquids – Waitsfield, VT

MBBR & Trickling Filters



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Lawson's Finest Liquids – Waitsfield, VT



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Lawson's Finest Liquids – Waitsfield, VT

Finished
Construction



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Others In Progress

- Brewster River Brewing – Jeffersonville, VT - Planning
- Tree House Brewing – Charlton, MA – Piloting
- NobleTown Brewing – Hillsdale, NY – Construction

Past Projects

- Alchemist Brewing – Waterbury, VT – Metering & Sampling
- Fiddlehead Brewing – Shelburne, VT – Capacity Allocation
- Lawson's Finest Liquids – Warren, VT – Permitting
- Collaborative Brewing – Waitsfield, VT - Design & Permitting
- Fat Orange Cat Brewing – East Hampton, CT – Design
- Great Marsh Brewery – Essex, MA - Design

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Key Wastewater Planning Considerations

- Every application is different
- Brewery wastewater is nutrient deficient
- Characterize your wastewater before doing anything else
- Use “Wastewater Process Engineer” with brewery experience
- There are no “black box” solutions
- Evaluate Costs (20-year life cycle)
- Evaluate Expandability of the WW System
- Pilot new equipment before design
- Involve community (WWTF) and State (Permitting) early
- Best management practices reduce treatment costs
- Design/Build approach can reduce construction cost

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Lawson's Finest Liquids

State of Vermont

Vermont DEC

Our Brewery Clients and Team Members



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Questions & Discussion



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Thank You for Your Time

